

# Variable S-Band High-Power Tuner

H. R. Buchanan

R. F. Systems Development Section

*A variable, high-power waveguide tuner that can be remotely controlled is being developed. Satisfactory operation at a 400-kW power level is the goal. Progress to date is reported.*

## I. Introduction

Recent measurements of the DSS 14 transmitter waveguide installation (Ref. 1) have emphasized the need for a compact tuning device that can be used at strategic points in the waveguide system to improve the match. This device must operate at 400 kW and have the capability of correcting a mismatch in the order of 1.10 to 1.15 voltage standing wave ratio (VSWR). A manually adjustable device that can be retuned a limited number of times has been developed for the immediate need (Ref. 2). This report describes a longer range development of a variable tuner that can be adapted for remote control and, if required, programmed control.

## II. Theory of Operation

The microwave circuit of the variable tuner is depicted in Fig. 1. A portion of the main WR 430 waveguide signal is coupled to an H-plane arm terminated in a variable position short. The short is a movable, noncontacting

type with a restricted range of motion to avoid operation at or near resonance. The short is an existing design that has been used satisfactorily at 20 kW.

The power level coupled into the H-plane arm is controlled by the diameter of the circular aperture in the side wall of the main waveguide. Figure 2 indicates the theoretical coupling as a function of the hole diameter with correction for the waveguide wall thickness (Ref. 1). When the H-plane arm is terminated by a short circuit, the mismatch introduced into the main waveguide is a function of the power coupling and the short position. Figure 3 indicates the theoretical susceptance variation (Ref. 1) calculated for aperture diameters of 3.81 and 4.70 cm. It is noted that the larger aperture affords a larger tuning range with a less steep slope in the negative susceptance region.

## III. Prototype Tests

A waveguide test sample has been fabricated and tested at low power, using several coupling aperture

diameters. The coupling measurement was made with the H-plane arm terminated in a matched load. Match measurements using a waveguide slotted line were made with the H-plane arm terminated in a laboratory model sliding short. The test results are plotted in Figs. 2 and 3 for comparison with theory. The agreement appears to be quite acceptable for small apertures, but less accurate for larger apertures. Nevertheless, the theory serves as a valuable tool for laboratory development.

#### IV. Future Plans

A high-power test model is now being fabricated using a coupling hole diameter of 4.7 cm. This aperture is expected to exhibit a coupling of 17 dB, resulting in a power level in the H-plane arm of approximately 8 kW. This model will include the noncontacting short and water-cooling. Tests at 400-kW will be made and reported at a later date.

### References

1. Matthaei, G. L., Young, L., and Jones, E. M. T., *Microwave Filters, Impedance-Matching Networks, and Coupling Structures*, McGraw-Hill Book Company, New York, 1964, pp. 229-242.
2. Loreman, J. R., "Adjustable Tuner for S-band High-Power Waveguide," in *The Deep Space Network Progress Report*, this issue.

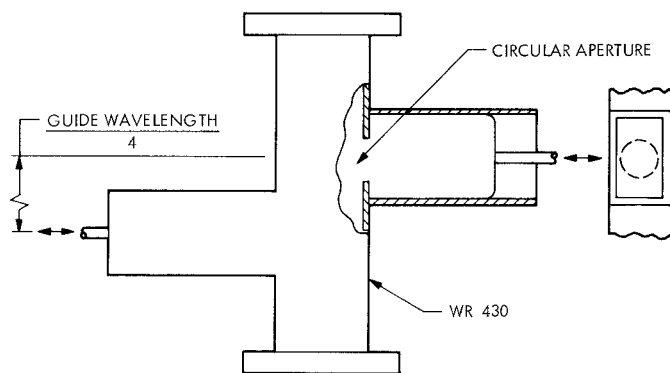


Fig. 1. High-power waveguide tuner

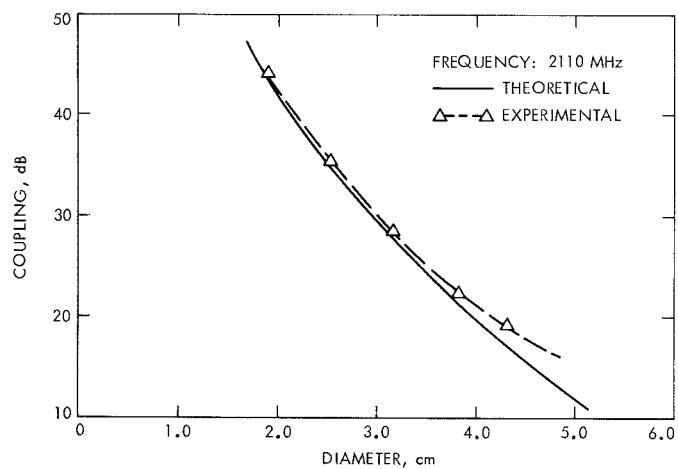


Fig. 2. Coupling vs aperture diameter

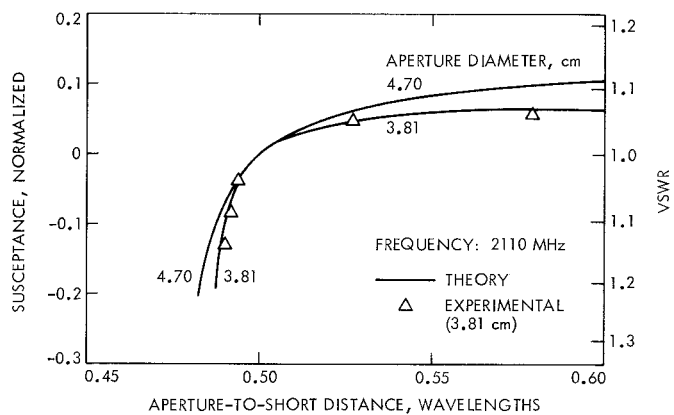


Fig. 3. Susceptance vs short position